CLAIMS

1. A telemetry system for transmitting an electromagnetic signal within a borehole, the system comprising:

(a) a borehole EM transceiver;

(b) a surface EM transceiver; and

(c) a signal wire with a first end comprising electrode means disposed within said borehole and a second end electrically connected to said surface EM transceiver; wherein

(d) said signal wire reduces attenuation of said signal transmitted between said surface EM transceiver and said borehole EM transceiver.

2. The telemetry system of claim 1 further comprising a ground wire with a first end electrically connected to said surface EM transceiver and a second end connected to a ground point remote from said surface EM transceiver.

3. The telemetry system of claim 2 wherein said signal wire is disposed in the annulus between the outer surface of a tubular and the wall of said borehole.

4. The telemetry system of claim 3 wherein said first end of said signal wire is connected to the outer surface of said of a tubular.

5. The telemetry system of claim 4 where said first end of said signal wire is electrically connected to the outer surface of said tubular.

6. The telemetry system of claim 4 where said first end of said signal wire is mechanically connected to the outer surface of said tubular.

7. The telemetry system of claim 3 wherein said surface EM transceiver is positioned above a surface of earth through which said borehole penetrates.

8. The telemetry system of claim 3 wherein:

(a) earth surface through which said borehole penetrates is covered by a body of water;

(b) said tubular extends above a surface of said body of water; and

(c) said borehole EM transceiver is disposed above said earth surface and within said body of water.

9. The telemetry system of claim 3 wherein:

(a) earth surface through which said borehole penetrates is covered by a body of water;

(b) said tubular extends above a surface of said body of water; and

(c) said borehole EM transceiver is disposed above said surface of water.

10. The telemetry system of claim 5 wherein said first end of said signal wire is affixed to an electrode structure that is electrically insulated from said tubular by a non conducting section of tubular.

11. The telemetry system of claim 1 comprising a second signal wire, with a first end comprising electrode means disposed within said borehole axially spaced from said first end of said signal wire and a second end electrically connected to said surface EM transceiver, wherein said signal wire and said second signal wire cooperate to reduce surface noise in said signal.

12. The telemetry system of claim 11 wherein said signal wire and said second signal wire are disposed within an annulus defined by an outer surface of said tubular and the wall of said borehole.

13. The telemetry system of claim 12 wherein said surface EM transceiver is disposed within said annulus.

14. The telemetry system of claim 12 wherein said surface EM transceiver is positioned above earth surface through which said borehole penetrates.

15. A measurement-while-drilling system for measuring a parameter of interest, said system comprising:

(a) a downhole assembly comprising a sensor, wherein said downhole assembly is terminated at lower end by a drill bit and at an upper end by a drill string operationally attached to a drilling rig;

(b) an electromagnetic telemetry system for transmitting an electromagnetic signal indicative of a response of said sensor, said telemetry system comprising

(i) a surface EM transceiver for receiving said signal,

(ii) a borehole EM transceiver for transmitting said signal wherein said borehole EM transceiver is disposed within said downhole assembly and operationally connected to said sensor, and

(iii) a signal wire with a first end comprising electrode means disposed within said borehole and a second end electrically connected to said surface EM transceiver; and

(c) a processor cooperating with said surface EM transceiver by means of a link to convert said signal into said parameter of interest; wherein

(d) said signal wire reduces attenuation of said signal transmitted between said surface EM transceiver and said borehole EM transceiver.

16. The measurement-while-drilling system of claim 15 further comprising a ground wire with a first end electrically connected to said surface EM transceiver and a second end connected to a ground point remote from said drilling rig.

17. The measurement-while-drilling system of claim 16 wherein said signal wire is disposed within an annulus defined by an outer surface of said casing string and the wall of said borehole.

18. The measurement-while-drilling system of claim 17 wherein said surface EM transceiver is positioned above earth surface through which said borehole penetrates.

19. The measurement-while-drilling system of claim 17 wherein:

(a) earth surface through which said borehole penetrates is covered by a body of water;

(b) said casing string extends above a surface of said body of water;

(c) said borehole EM transceiver is disposed above said earth surface and within said body of water; and

(d) said processor is disposed above said surface of said water.

20. The measurement-while-drilling system of claim 17 wherein:

(a) earth surface through which said borehole penetrates is covered by a body of water;

(b) said casing string extends above a surface of said body of water; and

(c) said borehole EM transceiver is disposed above said surface of water.

21. The measurement-while-drilling system of claim 15 wherein said first end of said signal wire is affixed to an electrode structure which is electrically insulated from said casing string by a non-conducting section of casing.

22. The measurement-while-drilling system of claim 15 comprising a second signal wire with a first end comprising electrode means axially spaced in said borehole from said first end of said signal wire and a second end electrically connected to said surface EM transceiver, wherein said signal wire and said second signal wire cooperate to reduce surface noise in said signal.

23. The measurement-while-drilling system of claim 22 wherein said signal wire and said second signal wire are disposed within an annulus defined by an outer surface of said casing string and the wall of said borehole.

24. The measurement-while-drilling system of claim 23 wherein said surface EM transceiver is disposed within said annulus.

25. The measurement-while-drilling system of claim 23 wherein said surface EM transceiver is positioned above earth surface through which said borehole penetrates.

26. A method for transmitting an electromagnetic signal within a borehole, the method comprising:

(a) providing a borehole EM transceiver;

(b) providing a surface EM transceiver; and

(c) reducing attenuation of said signal transmitted between said borehole EM transceiver and said surface EM transceiver by disposing a first end of a signal wire within said borehole and electrically connecting a second end of said signal wire to a terminal of said surface EM transceiver.

27. The method of claim 26 further comprising the additional steps of:

(a) electrically connecting a first end of a ground wire to said surface EM transceiver; and

(b) electrically connecting a second end of said ground wire to a ground point remote from said surface EM transceiver.

28. The method of claim 27 comprising the additional step of disposing said signal wire in the annulus defined by an outer surface of a tubular and the wall of said borehole.

29. The method of claim 27 comprising the additional step of connecting said first end of said signal wire to the outer surface of a tubular.

30. The method system of claim 29 where said first end of said signal wire is electrically connected to the outer surface of said tubular.

31. The method of claim 29 where said first end of said signal wire is mechanically connected to the outer surface of said tubular.

32. The method of claim 28 wherein said surface EM transceiver is positioned above earth surface through which said borehole penetrates.

33. The method of claim 28 wherein:

(a) earth surface through which said borehole penetrates is covered by a body of water;

(b) said tubular extends above a surface of said body of water; and

(c) said borehole EM transceiver is disposed above said earth surface and within said body of water.

34. The method of claim 28 wherein:

(a) earth surface through which said borehole penetrates is covered by a body of water;

(b) said tubular extends above a surface of said body of water; and

(c) said borehole EM transceiver is disposed above said surface of water.

35. The method of claim 30 comprising the additional step of affixing said first end of said signal wire to an electrode structure that is electrically insulated from said tubular by a non-conducting section of tubular.

36. The method of claim 26 comprising the additional step of reducing surface noise in said signal by providing a second signal wire with a first end disposed within said borehole axially spaced from said first end of said signal wire and a second end electrically connected to said surface EM transceiver, wherein said signal wire and said second signal wire cooperate to reduce said surface noise.

37. The method of claim 36 comprising the additional step of disposing said signal wire and said second signal wire within an annulus defined by an outer surface of said tubular and a wall of said borehole.

38. The method of claim 37 comprising the additional step of disposing said surface EM transceiver within said annulus.

39. The method of claim 37 wherein said surface EM transceiver is positioned above earth surface through which said borehole penetrates.

40. A method for measuring a parameter of interest while drilling a borehole, said method comprising:

(a) providing a downhole assembly comprising a sensor;

(b) terminating said downhole assembly at lower end with a drill bit and at an upper end by a drill string operationally attached to a drilling rig;

(c) advancing said borehole with said drill bit by rotating motion imparted to said bit;

(d) providing an electromagnetic telemetry system for transmitting an electromagnetic signal indicative of a response of said sensor, said telemetry system comprising

(i) a surface EM transceiver for receiving said signal,

(ii) a borehole EM transceiver for transmitting said signal wherein said borehole EM transceiver is disposed within said downhole assembly and operationally connected to said sensor, and

(iii) a signal wire with a first end disposed within said borehole and a second end electrically connected to a terminal of said surface EM transceiver;

(e) reducing attenuation of said signal transmitted between said surface EM transceiver and said borehole EM transceiver by use of said signal wire; and

(f) converting said signal to said parameter of interest with a processor cooperating with said surface EM transceiver by means of a link.

41. The method of claim 40 further comprising the steps of:

(a) electrically connecting a first end of a ground wire to said surface EM transceiver; and

(b) electrically connecting a second end of said ground wire to a ground point remote from said drilling rig.

42. The method of claim 41 comprising the additional step of disposing said signal wire within an annulus defined by an outer surface of said casing string and a wall of said borehole.

43. The method of claim 42 wherein said surface EM transceiver is positioned above earth surface through which said borehole penetrates.

44. The method of claim 42 wherein:

(a) earth surface through which said borehole penetrates is covered by a body of water;

(b) said casing string extends above a surface of said body of water;

(c) said borehole EM transceiver is disposed above said earth surface and within said body of water; and

(d) said processor is disposed above said surface of said water.

45. The method of claim 42 wherein:

(a) earth surface through which said borehole penetrates is covered by a body of water;

(b) said casing string extends above a surface of said body of water; and

(c) said borehole EM transceiver is disposed above said surface of water.

46. The method of claim 40 comprising the additional step of affixing said first end of said signal wire to an electrode structure that is electrically insulated from said casing string by a non-conducting section of casing.

47. The method of claim 40 comprising reducing surface noise in said signal by:

(a) providing a second signal wire;

(b) disposing a first end of said second signal wire within said borehole at a location axially spaced from said first end of said signal wire; and

(c) electrically connecting a second end of said second signal wire to a second terminal of said surface EM transceiver, wherein said signal wire and said second signal wire cooperate to reduce said surface noise in said signal.

48. The method of claim 47 comprising the additional step of disposing said signal wire and said second signal wire within an annulus defined by an outer surface of said casing string and a wall of said borehole.

49. The method of claim 48 comprising the additional step of disposing said surface EM transceiver within said annulus.

50. The method of claim 48 wherein said surface EM transceiver is positioned above earth surface through which said borehole penetrates.

51. The method of claim 40 comprising the additional step of transmitting a command to said downhole assembly by:

(a) generating a command signal indicative of said command by means of input into said processor;

(b) transferring said command signal to said surface EM transceiver via said link;

(c) transmitting said command signal with said surface EM transceiver; and

(d) receiving said command signal with said borehole EM transceiver.